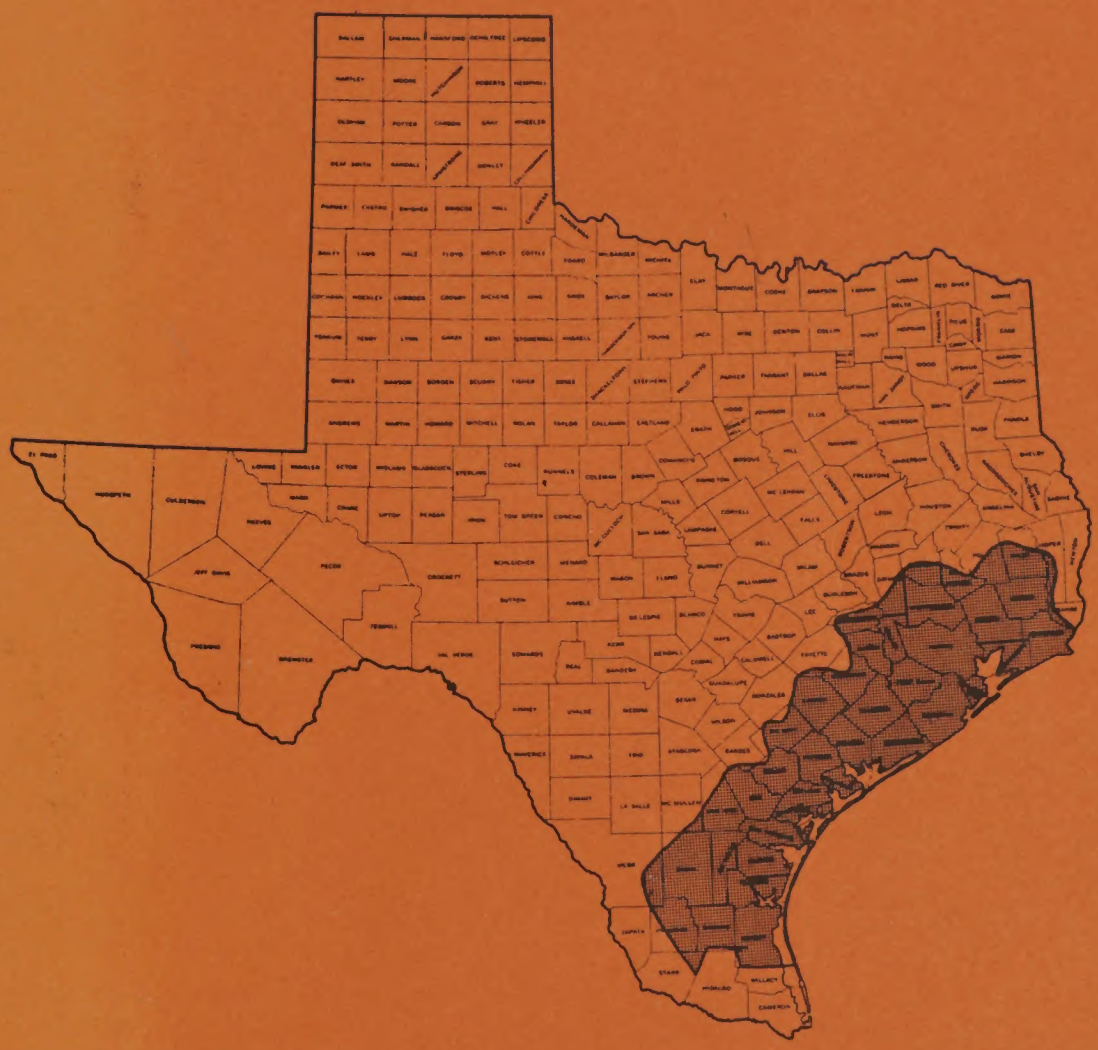
Plan of Work

TEXAS COASTAL BASINS



TYPE IV COOPERATIVE RIVER BASIN SURVEY

BY

THE UNITED STATES DEPARTMENT OF AGRICULTURE
IN COOPERATION WITH
THE TEXAS WATER DEVELOPMENT BOARD
THE TEXAS STATE SOIL AND WATER CONSERVATION BOARD
INTERAGENCY COUNCIL ON NATURAL RESOURCES AND THE ENVIRONMENT
THE TEXAS WATER RIGHTS COMMISSION

REVISED JULY 1975

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USDA-SCS-FORT WORTH TEX. 1975

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The United States Department of Agriculture
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PLAN OF WORK
TEXAS COASTAL BASINS

INTRODUCTION

The Texas Water Development Board and the Texas State Soil and Water Conservation Board have requested the United States Department of Agriculture to participate in a cooperative Type IV study of the Texas Coastal Basins. After the study began the Interagency Council on Natural Resources and the Environment and the Texas Water Rights Commission became cooperating agencies. The objective of the study is to determine water and related land resource projects and programs for solving problems and meeting needs of the area. The USDA has agreed to participate under the authority and provisions of Section 6 of Public Law 83-566, as amended.

This plan of work is a major revision of the previous plan of work. It was revised because additional time was required to complete the study as originally planned and to provide the necessary time for implementing the Principles and Standards for Water and Related Land Resource Planning.

An inventory of existing water and related land resources, problems, needs, and opportunities to meet current and future needs is essential in planning for optimum resource conservation development and utilization. It is necessary to develop understanding with individuals and groups involved so that coordinated plans can be developed which are in the best interest of all the people in the Texas Coastal Basins.

There is a need for a cooperative study so that various programs of the United States Department of Agriculture can be effectively coordinated with programs of State, other Federal, and local agencies.

It is essential that plans for water and land resource development in the Texas Coastal Basins, as for all regions of Texas be compatible with the principles, objectives, plans, and programs in the Texas Water Plan. It is also essential that the plans finally developed be compatible with efficient and effective land treatment programs, water management, administration, and supervision under applicable State and Federal authorizations and responsibilities.

DESCRIPTION OF STUDY AREA

The Texas Coastal Basins are located entirely within the State of Texas and include all of 24 counties and portions of 22 additional counties.

The area borders the Gulf of Mexico and includes all of the coastal basins and intervening areas between the Lower Rio Grande Valley and the Sabine River basin. Also included are: the Nueces River from its mouth to gaging station 8-2100 at Three Rivers; the San Antonio River from its mouth to gaging station 8-1885 on U. S. Highway 183 at Goliad; the Guadalupe River from its mouth to gaging station 8-1758 on U. S. Highway 77A at Cuero; the Colorado River from its mouth to gaging station 8-1610 on U. S. Highway 90 at Columbus; the Brazos River from its mouth to gaging station 8-1102 on State Highway 90 near Navasota, except the Navasota River; the Trinity River from its mouth to the Livingston dam site; and the Neches River from its mouth to B. A. Steinhagen Reservoir.

The study area is about 380 miles long and 70 miles wide and includes about 20,733,400 acres of land and 1,577,500 acres of water bodies over 40 acres in size, most of which is salt water in the bays and estuaries. It is characterized by the low topographic relief which is typical of the entire Gulf coastal plain. Elevations range from sea level to about 900 feet.

About 23 percent of the land area is cropland, 34 percent is range, 3 percent is marsh-rangeland, 21 percent is forest, 14 percent is pasture, and 5 percent is in miscellaneous use such as urban, roads, railroads, etc.

The climate is humid to semiarid. Average annual rainfall ranges from 26 inches at Kingsville to 55 inches at Beaumont. Occasional hurricanes origniate at sea and cross into the area from the Gulf of Mexico.

The underlying geological formations range in age from Recent on the coast to Oligocene in the interior and consist mostly of poorly consolidated sand and clay. The most significant geologic structural features are salt domes which are important sources of mineral wealth. The most important mineral resources are the organic minerals in the form of petroleum and natural gas. Tremendous reserves of both oil and gas have been proven on the land area and offshore on the Continental Shelf. The area includes the largest sulfur producing region in the United States and the value of sulfur produced is exceeded only by petroleum and natural gas. Natural salt production is important as are shell, gypsum, magnesium, bromine, sand, clay, uranium, and gravel.

The area includes portions of six land resource areas:

Gulf Coast Prairie	- 41 percent
Gulf Coast Marsh	- 2 percent
Blackland Prairie	- 5 percent

Rio Grand Plain	- 28 percent
Southern Coastal Plain	- 16 percent
Texas Claypan Area	- 8 percent

The dominant soils are dark-colored clay derived from calcareous clay. Alluvial soils border a few of the larger streams. Deep, sandy soils occur on dunes and beaches, and there are narrow strips of marshland along the coast.

Water resources consist mainly of ground water, streams, rivers which cross the area, and bay estuarine areas near the coast.

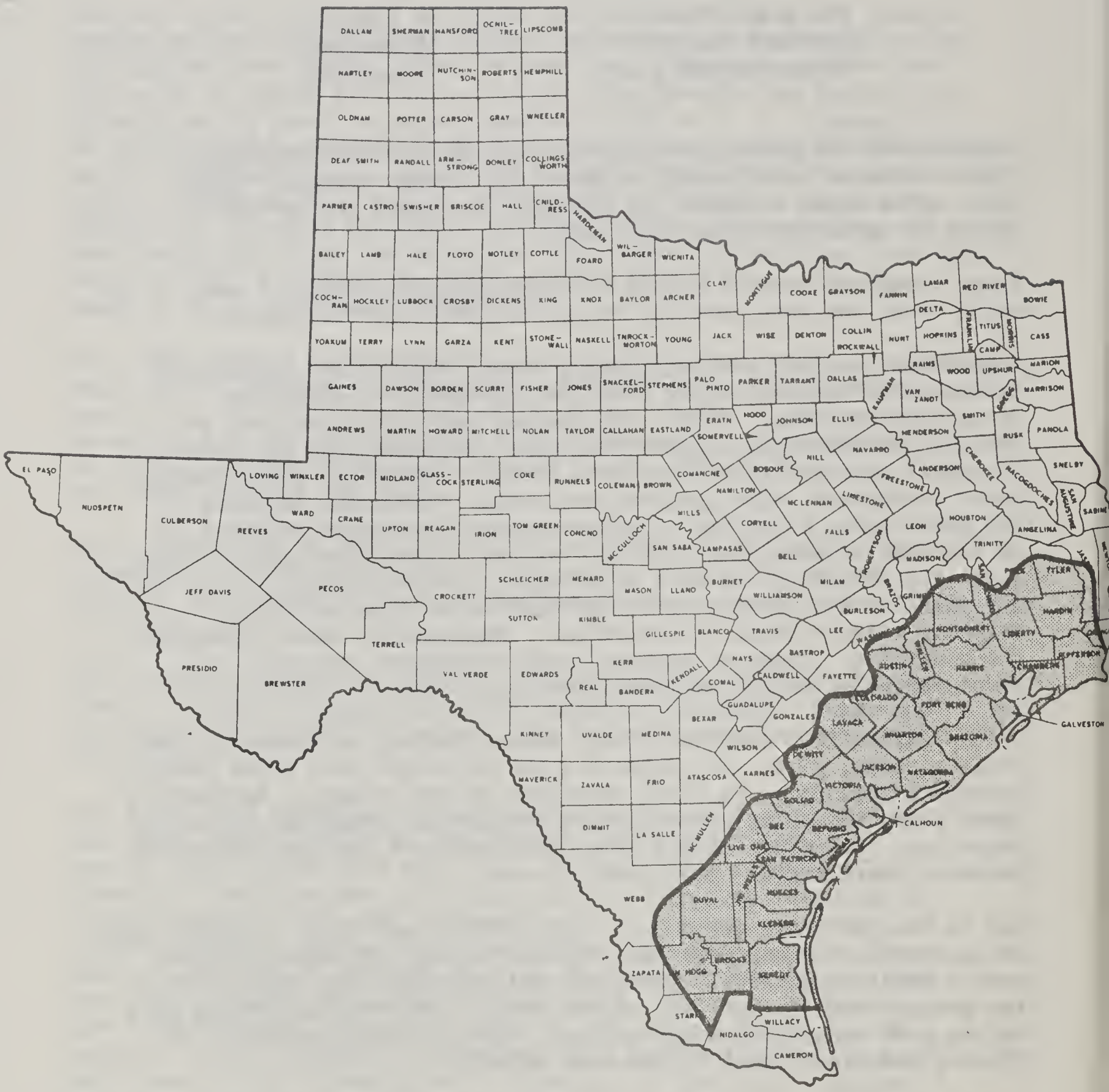
Vegetation consists of forest land, range, prairie and marsh, with habitat gradients developed from plant communities which are dynamic and diverse. These interspersed vegetative patterns are greatly influenced by a variety of land use trends and the amount of annual rainfall associated with natural features. Forest lands occur throughout, with concentrated areas of pine and hardwood in the upper zone; a variety of water-tolerant hardwoods and post oak in the middle zones, and chiefly live oak in the lower zone. Rangeland is confined to the more arid lower and middle zones. Prairies are found in all zones with the production of rice and grain sorghums being a haven for waterfowl. Marshes are found throughout the coastline. Zones of grasses, both freshwater and salt, are developed relative to sea level elevation.

Historically, this area has always been a farming and ranching area. Grain sorghum, rice, and cotton are the principal cash crops grown. Livestock production is still important to the economy. Agricultural lands along the coast are rapidly giving way to urban and industrial expansion. Principal cities along the coast are Houston, Galveston, Beaumont, Port Arthur, and Corpus Christi.

Due to the vast reserves of oil, gas, sulfur, and other minerals, and an abundance of cheap power and transportation, the area has grown into a great industrial, shipping, and manufacturing center. At the present time the oil and petro-chemical industry contribute more to the area economy than agriculture. Forestry and commercial fishing are significant to the area economy.

The population of the study area was 3.1 million in 1970. The increase over the 1940 population was 125 percent as compared to 77 percent for Texas and 54 percent for the United States.

In 1960, the urban population was 2,066,853 and amounted to 80.8 percent of the total population for the study area. Urban population increased 52.0 percent between 1950 and 1960 while total



STUDY AREA
TEXAS COASTAL BASINS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

USDA-SCS-FORT WORTH, TEX. 1971

population increased only 36.1 percent. Rural population decreased 5.5 percent during this period. Eight counties had no urban population in 1960. The rural farm population was only 4.4 percent of the total population of the study area in 1960 even though several counties had a farm population that exceeded 25 percent of their total population and in one county the farm population was almost 40 percent of the total population.

Based on the Water Resources Council's projections for water resource planning regions, the projected 2020 population is estimated at 7.4 million or 236 percent of the 1970 population. The United States 2020 population is estimated at 196 percent of the 1970 population.

STATUS OF WATER AND RELATED LAND RESOURCE PROGRAMS

U. S. Department of Agriculture

Soil Conservation Service

Soil and Water Conservation - The Soil Conservation Service, through its soil and water conservation program authorized by Public Law 46, cooperates with local groups and governing bodies, such as soil and water conservation districts as well as other State and Federal agencies, in the development and implementation of soil and water conservation programs. These programs serve individual, private, and public interests in the protection, use, and improvement of soil and water resources, for the sustained production of agricultural commodities and for the preservation and improvement of recreation, wildlife, and other renewable resources. A portion of this program is devoted to the procurement of essential data through soil surveys and to the interpretation of these data for nonagricultural as well as for agricultural purposes.

The owners or operators of 24,700 operating units, or 62 percent of the total units in the basins, were active cooperators with the 36 soil and water conservation districts located in the study area. Conservation plans have been developed for about 22,400 operating units. Operators of these units have made all necessary decisions, within practical limits, to use their land within its capabilities and to treat it according to its needs for maintenance and improvement of the soil, water, or plant resources. The operating units with conservation plans developed contain about 13,948,000 acres or about 75 percent of the total agricultural and forest land. During the reporting year of 1969 over 15,600 farm owners and operators were assisted by technicians of the Soil Conservation Service.

Soil surveys have been completed on about 10,973,000 acres in the study area.

About 6,460,000 acres, or 35 percent of the agricultural and forest lands are being used within their capability and all conservation practices that are essential to their protection and planned improvement have been applied. With proper maintenance, management, and application of measures for which the needs are recurring, these lands are capable of increased agricultural and forest production, wildlife enhancement, and recreation use.

Resource Conservation and Development - This program provides technical, financial, and loan assistance to local legal sponsors in approved areas where acceleration of going programs of resource conservation, development, and utilization will increase economic opportunities for local people. The program provides local leadership with the opportunity to coordinate and utilize local, State, and Federal facilities and techniques more fully in developing and carrying out a plan of action for the orderly conservation, improvement, development, and wise use of natural resources. Included are technical and financial help on conservation measures needed to reduce erosion, flooding, and sedimentation; advice on ground cover, shrub, and tree varieties available for beautification and wildlife; and planning assistance in developing outdoor recreation enterprises.

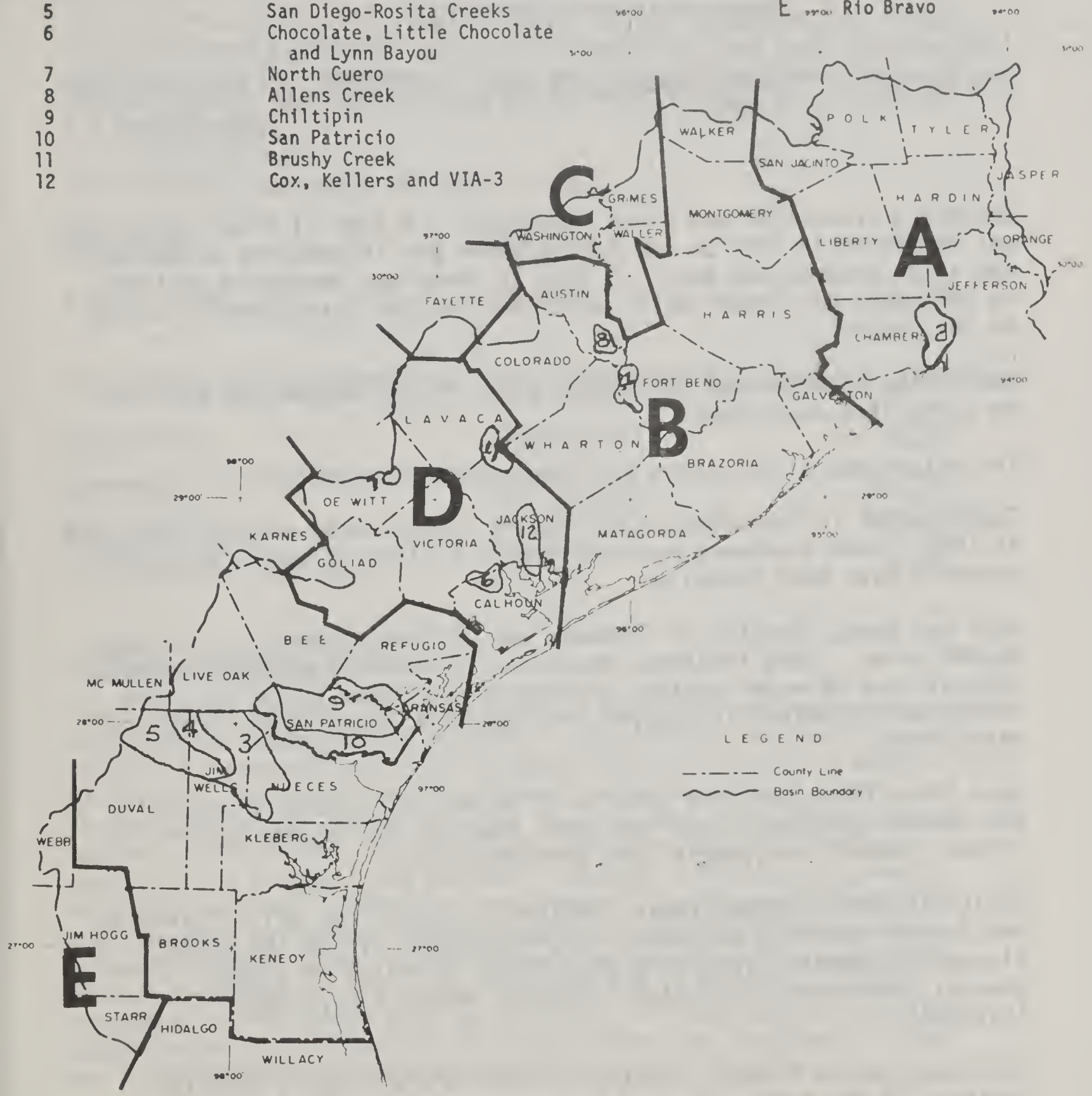
Resource Conservation and Development projects in the area are:

Project Name	Counties	Acres	Status
Southeast Texas	Polk, Tyler, Jasper, Newton, Hardin, Orange, Jefferson, Chambers, Liberty, San Jacinto, part of Galveston	5,774,254	Approved for Operations - 9/28/67
De-Go-La	Gonzales, Lavaca, DeWitt, Calhoun, Goliad,Jackson, Victoria	4,149,760	**
Sam Houston	Walker, Montgomery, Harris, Brazoria, part of Galveston, Austin, Colorado, Fort Bend, Matagorda, Wharton	7,300,966	Application Fwd. to Washington - 11/19/74

** Gonzales, Lavaca, and DeWitt authorized for Operations - 11/30/73
Calhoun, Goliad, Jackson, and Victoria approved for planning - 3/10/75

UPSTREAM WATERSHEDS	
No.	Name
1	Turkey Creek
2	East Bay Bayou
3	Agua Dulce Creek
4	Chiltipin-San Fernando Creeks
5	San Diego-Rosita Creeks
6	Chocolate, Little Chocolate and Lynn Bayou
7	North Cuero
8	Allens Creek
9	Chiltipin
10	San Patricio
11	Brushy Creek
12	Cox, Kellers and VIA-3

RC&D Areas	
Letter	Name
A	Southeast Texas
B	Sam Houston
C	Big 8
D	De-Go-La
E	Rio Bravo



UPSTREAM WATERSHEDS
AND
RESOURCE CONSERVATION AND DEVELOPMENT AREAS

TEXAS COASTAL BASINS

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SOIL CONSERVATION SERVICE
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May 1971

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Project Name	Counties	Acres	Status
Big 8	Leon, Robertson, Lee, Madison,Burleson,Brazos, Grimes,Waller,Washington	4,427,520	Authorized for Planning - 2/28/75
Rio Bravo	Webb, Zapata, Jim Hogg, Starr	4,321,280	Authorized for Operations - 12/23/74

Watershed Protection and Flood Prevention - A Type II river basin study was completed in 1967 on the Sabine River and Tributaries adjoining the study area to the east. A Type IV study was completed in 1969 on the Lower Rio Grande Basin which adjoins the Texas Coastal Basins on the south.

The status of watershed protection under PL-566 within the area can be summarized as follows:

The watersheds listed below are completed or construction is underway:

Turkey Creek in Fort Bend County covers 18,800 acres and was completed in 1960. Land treatment measures and 14.5 miles of multiple-purpose channels have been installed.

East Bay Bayou, located in Chambers and Jefferson counties, includes 36,000 acres. Land treatment measures, 20 miles of multiple-purpose channels and 26 water control structures have been installed. Ten of the water control structures provide for salinity control in the marsh area.

Agua Dulce Creek contains 228,720 acres and is located in Jim Wells and Nueces counties. Land treatment measures and 21.0 miles of stream channel improvement have been completed.

Chiltipin-San Fernando Creeks; located in Duval, Jim Wells, Kleberg, and Nueces counties; encompass 215,470 acres. Six of the eight planned floodwater retarding structures, 26 miles of stream channel improvement, and land treatment measures have been installed.

San Diego-Rosita Creeks, located in Duval and Jim Wells counties contain 222,450 acres. Ten of the eleven planned floodwater retarding structures and land treatment measures have been completed.

Chocolate, Little Chocolate and Lynn Bayou in Calhoun and Victoria counties cover 43,165 acres. Approximately three miles of the planned 70 miles of multiple-purpose channel have been completed.

North Cuero watershed in DeWitt County covers 12,608 acres. Both of the planned floodwater retarding structures have been constructed. Additional project measures to be installed include seven miles of stream channel improvement, two grade stabilization structures and 0.8 mile of dike.

The following watershed is being planned:

Watershed	County	Acres
Allens Creek	Austin	43,064

The following watersheds have been recommended for planning priorities:

Watersheds	County(ies)	Acres
Chiltipin	San Patricio	245,900
San Patricio	San Patricio	194,200
Brushy Creek	Jackson	20,528
Cox, Kellers, and VIA-3	Jackson	50,834

Economic Research Service

The Economic Research Service conducts national and regional programs of research, planning and technical consultation and services pertaining to economic and institutional factors and policy which relate to the use, conservation, development, management and control of natural resources. This includes their extent, geographic distribution, productivity, quality, and the contribution of natural resources to regional and national economic activity and growth. Also included are: resource requirements, development potentials and resource investment economics; impact of technological and economic change on the utilization of natural resources; resource income distribution and valuation; and the recreational use of resources. The agency also participates in departmental and interagency efforts to formulate policies, plans and programs for the use, preservation and development of natural resources.

Forest Service

Programs of the U. S. Forest Service provide technical assistance, information, service, and financial aid to State agencies responsible

for protection, management, and development of State, local, and privately owned forest lands. Some of the major forestry practices for which this assistance is available, normally through the Texas Forest Service are: fire control, insect and disease control, timber growing and harvesting, timber stand improvement and tree planting, watershed improvement, utilization and marketing of forest products, and multiple use planning. These National Forest System lands are managed under the concept of multiple-use to achieve a sustained yield of forest products and to enhance the environmental quality of the varied forest resources ranging in elements from timber through water, wildlife, forage, recreation, and others.

The Forest Service is conducting research in many phases of forestry which will have significant influence on watershed management, relationship between the forests and all aspects of water resources--erosion, water quality, floods, and water supply. The Forest Service also supports research programs through contracts with universities and private research institutes.

Sam Houston National Forest is located partially within the study area and occupies parts of Montgomery, San Jacinto, and Walker counties.

Public Law 93-86 amended and extended the Agricultural Act of 1970. This action established the Forestry Incentives Program (FIP). The purpose of the program is..."to encourage landowners to apply practices which will provide for afforestation,...reforestation,... and multiple-purpose management and protection of forest resources"... The law includes a cost-sharing provision tied to contracts and management plan development. This law will be taken into account as the forestry portion of the basin plan is developed.

Federal Extension Service

The Federal Extension Service is part of the Cooperative Extension Service partnership. Three levels of government, federal, state, and county; share in financing, planning, and carrying out extension educational programs. The Extension Service acts as an educational agency of the United States Department of Agriculture and Land Grant universities. County agents and extension specialists work with other agencies to provide local people information relating to soil and water conservation programs in all counties.

Agricultural Stabilization and Conservation Service

Agricultural Stabilization and Conservation Service administers the USDA Agriculture Farm Program relating to agriculture

production control. It administers specified commodity and related land use programs designed for voluntary production adjustment, and resource protection, and also administers price, market, and farm income stabilization programs.

Cost-sharing assistance to farmers and ranchers for application of practices to conserve the land and water resources within the basin will be provided through the Rural Environmental Conservation Program (RECP). This program is expected to be implemented after January 1, 1974.

Farmers Home Administration

The Farmers Home Administration of the U. S. Department of Agriculture makes water development and soil conservation loans to individual farmers, groups of farmers, and rural residents. These loans are used to develop water supply systems for irrigation, household, and livestock use; to drain farmlands; and to carry out soil conservation practices. In addition to loans to individuals, group loans are also available to local or organizations to help finance projects and develop land and water resources.

Rural Electrification Administration

The Rural Electrification Administration provides long-term, low-interest loans to qualified organizations for the purpose of supplying electrical service on a continuing basis to establishments in rural areas. The rates and conditions are comparable to those enjoyed by nearby urban consumers. Loans are also made for wiring of premises, plumbing, and electrical equipment and applicances, including machinery.

Agricultural Research Service

The Agricultural Research Service conducts research under four major categories; (a) farm research on crops and livestock and their diseases and pests, soil and water conservation and agricultural engineering; (b) utilization research and development; (c) nutrition and consumer use research; and (d) marketing research. Information both technical and popular is disseminated by bulletins and through other agencies and groups.

U. S. Department of the Army

Corps of Engineers

The Corps of Engineers has responsibilities in navigation, flood control, hurricane protection, water supply, shoreline erosion

assessment, flood plain identification and other allied fields. Numerous investigations and reports for civil-works projects are in varying stages of planning and development.

Navigation projects are primarily concerned with the maintenance of the Gulf Intracoastal Waterway and the extension of tributary channels inland into rivers and bayous. Many navigation projects also improve outlets for surface drainage. A major project under construction is the Wallisville Reservoir to facilitate navigation on the Trinity River.

Channel modification and levee protection are the most feasible means of flood protection in the study area. Barker and Addicks reservoirs in Harris County help control floods on Buffalo Bayou.

Hurricane protection is provided by a seawall constructed along a portion of the coastline to protect industrial and residential developments. Studies are underway to determine the feasibility of expanding seawall protection to all coastal areas.

Reports, which include considerations for many of the functions discussed above, have been completed on the Trinity River Basin, Brazos River Basin, Colorado River Basin, Neches River Basin, and the Guadalupe and San Antonio River basins.

Flood-Hazard reports are prepared by the Corps to provide the detailed flood information that is needed for economic studies, for formulating zoning regulations, and for setting design criteria to minimize future flood losses.

U. S. Department of the Interior

Bureau of Reclamation

The Bureau of Reclamation provides loans and grants for the rehabilitation or construction of water supply projects. Projects must be primarily for irrigation, but multipurpose projects incorporating municipal water supply and flood control may be included.

In February 1965, the Bureau of Reclamation prepared a plan of development of the Texas Basins Project. The project is designed primarily to provide major new municipal, industrial, and irrigation water supplies to support long-term expansion of Texas' economy.

In January 1965, the Bureau of Reclamation prepared a plan of development for the Cuero Dam and Reservoir on the Guadalupe River and Sandies Creek to regulate their flows for municipal and industrial water supply and flood control purposes.

The proposed Confluence Reservoir, located near the mouth of the Guadalupe River Basin would be a facility of the Coastal Canal of the Texas Water System, and would be used primarily for re-regulation.

Reservoirs being considered in the Nueces River Basin are R&M located below Lake Corpus Christi and Choke Canyon which is out of the study area.

Palmetto Bend Reservoir is a proposed Bureau of Reclamation project which would be located in the lower portion of the Lavaca River Basin. This reservoir would supply part of the water requirements in the adjoining Colorado-Lavaca and Lavaca-Guadalupe Coastal basins.

Bureau of Sport Fisheries and Wildlife

Four national wildlife refuges include Anahuac in Chambers County, Aransas in Aransas and Refugio counties, and Brazoria and San Bernard in Brazoria County. These refuges, which harbor millions of ducks and geese every winter, are known as southern terminals of the great central flyway. The whooping cranes winter in the Aransas National Wildlife Refuge.

National Park Service

The National Park Service has responsibilities to preserve archeological and historic resources. It is responsible for the preservation and development of the 132,212 acre Padre Island National Seashore located between Corpus Christi and Brownsville; 100,000 acres of which are located within the study area. This area was designated in 1963 as one of seven established national seashore areas.

Geological Survey

The Geological Survey, in cooperation with State and local agencies, has ground water studies either completed or underway in many counties within the study area. The GS also compiles information and keeps streamflow and lake elevation records on the major streams and lakes as well as preparing topographic maps.

Flood-prone area maps are prepared by the USGS for use by administrators, planners, and engineers concerned with future land developments to show those areas that are subject to flooding.

Bureau of Outdoor Recreation

The Bureau of Outdoor Recreation, through a planning grant, is helping to finance a Statewide Comprehensive Outdoor Recreation Plan for the State of Texas. This plan is scheduled for completion in 1974.

U. S. Department of Housing and Urban Development

Federal Insurance Administration

The Federal Insurance Administration administers the National Flood Insurance Act of 1968 which was passed to provide flood insurance in flood-prone areas. This insurance is available through the cooperative effort of the Federal government and the insurance industry. The Act requires that State and local governments also contribute by adopting and enforcing land use provisions to restrict future development in flood-prone areas. Many property owners within the Texas Coastal Basins are participating in the program.

U. S. Department of Commerce

The Coastal Zone Management Act of 1972 (PL 92-583) will be administered by the Secretary of Commerce, who is required, in carrying out his functions and responsibilities under the Act, to cooperate and coordinate his activities with other interested Federal agencies. The Act establishes a national policy and develops a national program for the management, beneficial use, protection, and development of the land and water resources of the Nation's coastal zones and for other purposes.

National Oceanic and Atmospheric Administration
National Marine Fisheries Service

The National Marine Fisheries Service reports the commercial landings along the Texas coast. A Biological Laboratory in Galveston is engaged in research on marine life in the bays and on the continental shelf with emphasis on shrimp. A Marine Sportfish Laboratory is under construction at Port Aransas.

Economic Development Administration

The primary function of the Economic Development Administration is the long-range economic development and programing for areas and regions of substantial and persistent unemployment and underemployment and low family income through the creation of new employment opportunities by developing new and expanding existing facilities and resources.

Environmental Protection Agency

The Environmental Protection Agency deals with air and water pollution, water hygiene, solid waste management, radiation, and pesticides.

Texas State Agencies

The Texas Water Development Board administers the Texas Water Development Fund which provides financial assistance and aid to various political subdivisions in the conservation and development of the water resources of the State. The Board functions also include the preparation of a comprehensive state water plan and the continuation of technical programs related to water availability, water quality protection, reclamation, and water related services.

The State Soil and Water Conservation Board's activities are primarily directed along three lines: (1) to perform state-level administrative functions incident to the organization and operation of soil and water conservation districts; (2) to coordinate the programs of the soil and water conservation districts; and (3) to administer state responsibilities in the upstream watershed protection and flood prevention program.

The Interagency Council on Natural Resources and the Environment is responsible for the Coastal Resources Management Program by developing an environmental analysis of the coastal resources and the coastal problems of Texas and recommending to the Governor and the Legislature alternatives on how the State should plan, manage, and develop the coastal zone environment.

OBJECTIVES

The objectives of the Texas Coastal Basins study are:

A. To formulate alternative plans that satisfy the study items and accommodate one or more of the following major objectives:

   1. To enhance national economic development (NED) by increasing the value of the nation's output of goods and services and improving national economic efficiency.

   2. To enhance the quality of the environment (EQ) by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems for the benefit of mankind.

B. To provide the basis for evaluating and displaying beneficial and adverse effects of alternative plans in four public information accounts embracing the above objectives and the following:

Social well-being (SWB); which elements include the equitable distribution of real income, employment, and population, with special concern for the impacts of a plan on affected persons or groups; contributing to the security of life and health; educational, cultural, and recreational opportunities; and national security.

Regional development (RD); through increases in a regions' income; increases in employment; and improvements of its economic base, environment, quality of life, and other specified components of the regional objective.

C. To assist local and regional decision makers select their plan from the various alternatives.

All interests concerned with land and water resources will be fully considered. This includes public and private, national, regional, state, and local.

Though related to the above, a more specific USDA objective of this study is to facilitate and coordinate the orderly conservation, development, utilization, and management of water and land resources. The patterns of water and land use estimated to be the most appropriate to meet needs projected for 1980, 2000, and 2020 will be described. Also specific watershed projects necessary to meet local and national social and economic needs will be proposed. The consequences of alternative patterns and schedules of development will be evaluated. Information developed will be used to coordinate the USDA's water and land resource conservation and development programs with those of the Texas State Water and Land Resources Plans, and those of other Federal agencies. Information and data obtained will be compiled in such a manner that it may be used in planning action programs for water and land resource conservation, development, utilization, and management.

During the course of the different phases of the study, consideration will be given to additional needs and desires related to the above objectives identified by the local people and their representative organizations.

STUDY ITEMS

Throughout the planning process specific components of the major objectives that are significantly related to the use and management of the resources will be ascertained and identified. These will be expressed in terms of needs and problems in the context of multi-objectives.

A number of items of concern to basin inhabitants have been identified that are related to the land and water resources of the basin. Study of these items will reveal opportunities to remove constraints and alleviate problems that deter national economic development and improve the management and allocation of limited resources to a accomplish one or more of the major objectives.

Floodwater Damages: Flood problems are of two distinct types. One is associated with floods that occur in the upstream watersheds along streams having well-defined flood plains. Floods in the upstream watersheds generally rise and fall quickly and have high velocities and high peak discharges. Damages per acre inundated from floods in the upstream reaches are usually lower than those occuring downstream due to less intensive use. Where damage occurs the ever present flood hazard may be a deterrent to more intensive use of these flood plains.

The other type of flood problem is associated with accumulation of run-off on the almost flat terrain of the coastal areas. Control and disposal of this surface run-off is one of the most serious water problems faced by cities and farming communities. Floodwaters interrupt transportation and drown crops, damage houses and stores, and interfere with the proper treatment of sewage.

Flood-producing storms can occur at any time of the year; however, they occur most frequently during the spring and fall months. Floods occur in some parts of the study area each year. These are usually caused by local storms of high intensity. Widespread flooding is associated with storms covering large areas and with heavy rainstorms that accompany hurricanes. Some of the more recent major floods associated with hurricanes are Carla, 1961; Cindy, 1963; Beaulah, 1967; Celia, 1970; and Fern, 1971.

Flooding and subsequent floodwater damage is a major problem on agricultural lands. Most of the floodwater damages are caused by ponding of excess water from rainfall. Water tends to accumulate rather than run off because of the flat topography, lack of natural channels and inadequate drainage systems.

Highways, roads, railroads, and irrigation canals have been built across the study area in all directions. These manmade obstructions block natural flows and cause inundation of large areas of cropland and improved pasture. In many cases these restrictions cause water to stand for long periods in highly developed urban areas, resulting in extensive damage to property and loss of business. Often schools are forced to close for several days until the water recedes. Flooding of sanitation facilities compounds the health hazard.

There are about 3,300,000 acres of agricultural, residential, industrial, and urban land which are subject to damage from floodwater; however, there are about 2,332,000 acres on which it is feasible to alleviate floodwater damage.

Impaired Drainage: Most of the residents of the study area recognize the fact that drainage conditions are poor. These people are divided in their opinions as to whether or not improved drainage facilities are needed. All admit that excess surface water causes crop damage at times, but some believe the damages are more than offset by the benefits from the conserved moisture.

Many drainage systems and isolated ditches have been constructed by drainage districts, counties, individual landowners, irrigation districts, and cities in an effort to improve the drainage conditions of their respective localities. These facilities have improved drainage conditions to some extent. Much work has been done on the upper reaches of natural streams that serve as outlets for many of the systems. Damages have been caused further downstream by the faster concentrations of run-off water from the improved facilites. The problem is that the systems do not have adequate outlets.

From Victoria and Calhoun counties southward, there are numerous swales and potholes. These are local terms for two types of natural depressions. The term "swales" usually means a wide, shallow, meandering depression that does not have a definite or continuous channel, but does have an outlet. Such depressions are often the headwaters of the local streams. Isolated depressions with no outlets are referred to as "potholes;" however, the term "swales" is sometimes applied to these also. The run-off water from surrounding areas collects in the bottoms of these depressions and remains there until removed by evaporation or absorption. Crops are seriously damaged or destroyed. These depressions do not have outlets and do not follow definite patterns. Since this is in the low rainfall section of the study area and moisture conservation is important, level terraces reduce the amounts of water reaching the bottoms of these depressions and conserve moisture.

On rangelands, the lack of continuous of definite channels in the swales causes lakes of various sizes and depths to remain after most of the surface water has drained off. These low, wet places become breeding and concentration places for cattle diseases. The standing water damages or destroys the pasture grasses; thereby, reducing the grazing area. Potholes create the same problem.

Large acreages in the bottomland of the Neches, Trinity, Brazos, San Bernard, Guadalupe, and Nueces rivers cannot be feasibly

drained until the floods that occur on these streams are brought under control. Each flood would partially or completely fill any drainage installations with silt and debris.

The marsh areas in Orange, Jefferson, and Chambers counties present a problem which is closely connected with draining the adjoining farm and ranch lands. Large sections of the marshes are used for wildlife and these will have to be protected where drainage outlets are constructed to the Gulf.

Drainage ditches have been installed for many years, but their adequacy has failed to keep pace with the needs, especially in the areas of urban run-off. Most systems at present are only partially effective due to lack of capacity, improper maintenance, deterioration of structures, and most important the absence of adequate outlets.

There are about 4,698,000 acres of agricultural land, including areas presently drained, on which impaired surface drainage, normal tidal action, seepage, or excess irrigation water limit agricultural or forest production. About 1,826,000 acres or 39 percent of this area is not adequately drained and project action is required to provide outlets.

Water Quality: Water quality problems can be classified as either natural or manmade. Natural problems occur usually as an excess of certain constituents which have been picked up by the water through contact with the ground. These include iron, silica, flouride, nitrate, chloride, sulfate, calcium, sodium, sediment, and organic materials. Manmade water quality problems are usually the result of the dumping or discharge of solid and liquid materials into natural water systems in such quantities that it is impossible for the assimilative properties of the system to degrade their toxic or esthetic effects to an unobjectionable level. The vast majority of the water quality problems in the study area are of manmade origin.

Municipal and industrial wastewater from urban run-off and from sewage plants lowers the quality of the streams into which it is discharged. Some municipal and industrial sewage treatment plants within the study area release effluent which is not completely treated and which has a high biochemical oxygen demand. This effluent also contains suspended and dissolved organic and inorganic materials which affect the quality of the water. Many wastewater treatment plants within the study area were not designed to treat the quantity of wastewater which now flows into the plant. Therefore, they are overloaded and at best can only provide an effluent which is partially treated.

Salt-water intrusion into the aquifer along the coast has degraded the quality of ground water in the Houston-Pasadena area. Run-off from cattle feedlots pollutes the water in several streams within the study area. This type of waste has a high biochemical oxygen demand and creates anaerobic conditions which are damaging to fish habitat and give off offensive odors. Industrial waste is discharged into Nueces Bay along the south shore by industries lining the Corpus Christi ship channel. The paper and pulp processing mills in the eastern portion of the study area discharge treated waste into the watercourses.

In the San Jacinto River Basin, decay of natural vegetation in the densely forested northeastern part of the basin imposes an oxygen demand on several streams in this area and creates dissolved-oxygen depressions locally during summer months. Low flows in the Nueces River basin are relatively highly mineralized, principally as a result of irrigation return flows and the discharge of municipal wastewaters. The flow below Lake Corpus Christi is frequently saline as a result of inflow of saline ground water and drainage from oil field areas.

Water Shortage: Areas which face critical water shortages in the future include the Houston metropolitan area and the Corpus Christi and Kingsville areas. The Corpus Christi and Kingsville areas will probably develop a shortage of fresh water around the year 2000 even considering the yield of the proposed R&M or Choke Canyon reservoir. Other major problems relating to water supply in the study area include water quality management, land subsidence, and saline ground water intrusion in the Gulf Coast aquifer. As inland fresh-water supplies are progressively developed and used, fresh-water fnflows to the bays and estuaries will be correspondingly diminished.

Land subsidence, resulting largely from localized intensive ground water pumpage and also withdrawals of petroleum, natural gas, and brine from hydrocarbon reservoirs, is a very severe problem in Orange County, along the Houston ship channel and in the Baytown vicinity. Along the Houston ship channel the ground has subsided as much as five feet since 1943. Heavy ground water pumpage has also caused saline water intrusion in the Texas City and Baytown areas.

The rate of natural recharge is estimated to be sufficient to sustain the present level of pumpage from the aquifer except in the Houston metropolitan area. The principal problem restricting maximum development of the aquifer is the limited capability of the aquifer to transmit water from areas of recharge to areas of pumpage.

Economic Conditions: Population of the study area has increased rapidly in the past thirty years. It increased 125 percent from 1940 to 1970 while the population for Texas increased 77 percent and the national population increased 54 percent. It is expected that the population of the area will continue to increase with a major portion of the increase being associated with increased employment in the heavy water using industries such as "Chemical and Allied Products and Primary Metals." Economic growth is not uniform over the area as many counties have actually been losing population.

Per capita income for the study area is still less than the national average though it has been increasing at a faster rate. In a large portion of the study area it was only 75 percent of the national per capita income in 1965.

Rapid industrial growth concentrated in portions of the area is placing increasing pressure on the area resources and the environment, yet benefits such as increased income and an increasing or stable population is not occurring in many parts of the area. Industrial growth is affecting the availability of resources for agriculture use while at the same time changes in agriculture production practices including land use is affecting environmental conditions.

Projected demands on the land and water resources from industrial growth and need for agricultural production both in terms of need for food and fiber and the associated production costs and in terms of opportunities for improvement of social and economic conditions will be investigated and become an integral part of the evaluation technique employed to determine the merit of altering resource use.

Recreation: The study area is witnessing a greater demand for and pressure on recreation resources. A rapidly changing American culture has brought about increases in disposal income and leisure time, greater population mobility, and a general increase in living standards. At the same time increasing population, urbanization, and industrialization have combined to diminish potential recreation areas.

A persistent problem in outdoor recreation is the difficulty in coordinating efforts by private, local, state, and federal organizations in inventorying and developing recreational facilities. There is also difficulty in establishing meaningful criteria to evaluate present deficiences and future requirements.

Water-oriented recreation is confined largely to coastal waters of the Gulf due to the absence of reservoirs and state parks with water bodies. The continuing capability of the coastal area to provide adequate recreation is being impaired because of increasing expansion of industrial and private development along

the coast. Public access to beaches from mean low tide to the vegetation line is set forth in the "open beaches" law, but the area is undefined along vast stretches of the coast. There is also a recognized shortage of access roads to bays, estuaries, and other existing public waters.

Other problems affecting recreation in the coastal area include shoreline erosion, tidal damage, and pollution. High tides, due to hurricanes, inflict heavy damage to barrier islands and beaches. Pollution is a very serious threat to outdoor recreation largely due to heavy use of the coastal waters for transportation, industrial purposes, and as a disposal area for by-products of an affluent society. Indiscriminate dumping of foreign matter into bays, estuaries, and coastal streams kills fish, damages habitat, and deters swimming and boating activities.

There are problems in securing land for recreational opportunities where it is most needed, near densely populated metropolitan areas.

Recreation has not been able to compete successfully with other uses for land. This situtaion is complicated by the lack of land use guidelines which could encourage the purchase of land for open space and recreational areas.

Fish and Wildlife: The principl concerns associated with fish and wildlife management are loss and modification of habitat, pollution, deficient wildlife populations where there is good habitat, inadequate harvests due to limited access, and lack of incentives for private landowners to emphasize wildlife management in their agricultural operations.

Various segments of society place different values on fish and wildlife. The landowner may value these resources for the income he derives from hunting and fishing fees. To the sportsman fish and wildlife represent the opportunity to enjoy nature while in pursuit of his quarry. Others feel that wildlife are important for their contribution to esthetics and value to natural ecosystems. Some feel that fish and wildlife resources are subservient to technological progress. Plans for solving fish and wildlife problems must include compromises and trade-offs by all segments of society.

Habitat loss and modification in the bay systems and marshes affect both the fishing habitat and wetland wildlife habitat. Sediment is the product of erosion primarily from unprotected upland areas, streambanks and construction sites. The sediment finds its way into coastal water bodies supplying essential

nutrients, maintaining shoreline areas subject to erosive forces, and carrying materials toxic to fish, wildlife and people. Dredging of channels and deposition of spoil can change the hydrological characteristics of the area by partitioning a bay or otherwise altering current patterns.

A major problem is the loss of shallow nursery habitat caused by the construction of bulkheads and subsequently filling the area behind them. Also whenever areas subject to normal tidal inundation are leveed making them non-tidal, valuable spawning and/or nursery areas for marine fishes and crustaceans are usually lost.

Salinity variations in wetlands and bays are greatly affected by freshwater inflow. Both extremes have been experienced in the Texas Coastal Basins. In the lower half of the coastal area where average annual rainfall is below 30 inches, high salinity due to reduced fresh-water inflow is a problem. In the upper half of the coastal area excessive fresh-water inflow has been responsible for occasional oyster die-off but such flows result in increased production in following years by supplying nutrient materials. Information is needed concerning the amount and timeliness of fresh-water inflow to bays and estuaries. Industrial, domestic, and agricultural pesticide pollution result in losses of fishery resources by causing direct mortalities, decreased reproductive potential or by rendering them unfit for consumption.

Upland wildlife habitat modification and loss can be attributed to technological advances of man. Land is cleared of woody vegetation to make way for more improved plant species. Wildlife may be severely affected if a monoculture results which furnishes little wildlife food and cover.

Industrialization, and subdivision of large rural tracts of land for country homesites have placed additional pressure on wildlife habitat. The mere presence of people forces the migration of some wildlife species to other areas. Many time homesites along streams and lakes are also preferred wildlife areas. Wildlife populations within the sphere of influence of these developments are also affected.

Pollution of water areas in the Texas Coastal Basins has resulted in the degradation of the fishery resource. In volume sediment is the prime pollutant in inland water bodies. Industry, ships, cities, and towns find it convenient to dump wastes into water areas. Chemicals and fertilizers from agricultural operations also contribute to the pollution problems.

Game populations are below their potential in the forestland of the upper coastal wildlife habitat due primarily to poor distribution of food plants, difficulty in enforcing game regulations, and lack of appreciation for sound wildlife management practices and techniques.

Wildlife management on a broad scale is far from simple. This has resulted in wildlife populations fluctuating from high to little or none depending upon the area and habitat. The enforcement of game laws pertaining to seasons and bag limits is difficult to achieve in some areas. In other areas where enforcement is not a limiting constraint, proper hunting regulations and harvest methods have not produced expected results. A breakdown in communication between landowners and wildlife officials, in matters pertaining to management practices, harvest methods and numbers to be harvested, has also decimated game populations in some locations. Multiple land use based only on immediate economic return results in wildlife receiving the least emphasis in management practices. Intensive use of the land as cropland, pastureland, or rangeland often brings about degradation of wildlife habitat.

Erosion: Erosion by water within the study area displaces about 24 million tons of soil each year. The erosion rates within the basin vary considerably because they are influenced by land use, soil type, rainfall, and physical characteristics of landscape all of which have considerable ranges within themselves. The lowest rates, one ton or less per acre, are in the flat lying coastal areas of primarily clayey soils, and the highest are in areas of gully erosion in San Patricio County.

Critical erosion is occurring on portions of the Gulf Coast Prairie Land Resource Area occupied by Victoria clay soils in San Patricio County. These soils have a high shrink-swell ratio and are somewhat dispersed, especially when soluble salts from oil field pollution are present. Extensive cracks develop when these soils dry, causing them to become highly susceptible to gully-like erosion. Near vertical banks form, and blocks of dry soil crack off into the ditch bottom. Several drainage ditches have been cut against grade into Nueces Bay from the north in these soils. Considerable erosion of the banks and beds has caused these ditches to deepen and widen in an uncontrolled manner forming unsightly gullies and depositing large quantities of sediment in Nueces Bay. Stabilization structures have been installed in several of these eroding ditches. Due to the difficult soil conditions, proper design and installation of these measures are mandatory to decrease the risk of failure. Several eroding ditches are present which drain northward and empty into Chiltipin Creek. Some gully

erosion is present in the upland portions of the Guadalupe and the San Antonio River basins, and has contributed to the large sand bedload of Coleto, Perdido and Turkey creeks in the Guadalupe River basin and Manahuilla Creek in the San Antonio River basin.

Active streambank erosion was observed along many of the streams and tributaries in the upland watersheds, particularly in the Guadalupe River basin. Active bank erosion is occurring along several of the major rivers; most noticeably the Brazos River. This is a natural process and is the means by which the rivers meander back and forth across their valleys to build wide, flat, flood plains.

The principal wind erosion problem is located in eastern Kenedy County on what is known as the Laguna Madre Salt Flats between Padre Island and the mainland. Construction of the Intracoastal Waterway effectively drained these flats so that they are dry a large part of the time and subject to erosion by the prevailing southeast winds. Also, extensive grazing on Padre Island in the past and wind erosion of the spoil banks along the Intracoastal Waterway contribute to the problem. The prevailing winds pick up salt laden dust and sand, and blow it into the waterway and far inland where it is deposited on vegetation. The resulting defoliation of the vegetation promotes the creation and movement of sand dunes across Kenedy County from the southeast. The deposition of sand in the waterways is a maintenance problem as is the deposition of salt on transformers and power lines. No other parts of the study area appear to have a significant wind erosion problem.

Shoreline erosion is significant along many miles of bay and estuary shore behind the barrier islands and on the open Gulf shore where no barrier island is present. Erosion on the Gulf beaches of the barrier islands is generally not important or relevant. Erosion of the shoreline is causing a loss of land and improvements and is contributing to the pollution of the bays and estuaries. Recreational beaches are being damaged in some areas and the erosion is contributing to the maintenance requirements of channels and waterways.

A study of shoreline erosion has been conducted by the U. S. Corps of Engineers under the authority of Section 106, Public Law 90-483. The SCS furnished available data on areas of shoreline erosion.

The Corps of Engineers study showed that about 350 miles of shoreline is eroding and is resulting in the loss of about 125 acres of land annually. This study also shows that about 36 miles of Gulf shoreline and about 57 miles of bay and estuary shoreline is

classed as having critical erosion. Erosion was termed critical when evaluation indicated that action to halt such erosion may be justified. About 65 miles of Gulf shoreline is classified as having noncritical erosion. These studies show that major areas of critical shoreline erosion include the north shore of Nueces and Corpus Christi bays, the west shore of Lavaca and Matagorda bays, the west shore of Galveston Bay, and the open shoreline from Port Bolivar to the Sabine River.

Sedimentation: The study of sediment production and deposition in the study area can be divided into two categories: (1) that which originates outside the study area, and (2) that which originates within the study area.

Sediment which originates outside the study area is transported into and through it by the seven rivers on their way to the Gulf. It is estimated that under present conditions these rivers deposit a total of about 15,000 acre-feet or about 23,690,200 tons of sediment to the bays and estuaries annually, of which about 6,442,200 tons originate within the study area and 17,248,000 tons from outside the study area. It is estimated that 60 to 70 percent of this sediment is deposited in the bays and estuaries, the remainder entering the open Gulf through openings in the barrier islands. By far the largest sediment load is carried by the Brazos River which accounts for about 15,196,500 tons. A comparison of old and new bathometric charts indicates that the bays and estuaries are filling at an average rate of about 1.25 feet per century. Studies have shown that the filling rates of the bays and estuaries are actually about double the rate indicated by the bathometric depth changes. Subsidence within the Gulf coast geosyncline accounts for the difference. Indications are that recent dams on the rivers along with installation of of needed soil conservation measures such as land treatment and flood prevention structures has probably altered this rate, causing a considerable decrease. This is confirmed by an analysis which was made of the sediment loads of the major rivers during a 35-year period ending in 1965.

Particularly noteworthy is the large quantity of sediment carried by the Brazos River as compared to the Trinity and Colorado. A sharp decrease in the load carried by the Colorado occurred after the installation of the dams at Austin. It is interesting to note that the Brazos and Colorado historically have carried very large sediment loads and this apparently correlates with their being the only two major rivers which have completely filled their drowned estuaries. With the reduction of sediment from inland sources due to dam building and soil erosion prevention measures, it is quite possible that the rate of shoreline erosion around the

bays and estuaries will increase, due to the upsetting effect on the deposition-erosion equilibrium.

Several spectacular examples of accelerated sedimentation are present in the study area. One example is the deposition of significant amounts of sediment in Nueces Bay as a result of degrading drainage ditches along its north shore. Several deltas covering many acres have been built at the mouths of these drains within the last 30 years. One such delta, at the mouth of Gum Hollow Creek, occupies an area of 127 acres and actively advances itself after every heavy rain on its contributing watershed.

This erosion and deposition is the result of the construction of an artificial drainage system to drain the area between the towns of Portland and Taft. The outlet of the manmade system was into Gum Hollow Creek, which until that time had a very small drainage area. Early growth of the fan delta was rapid because of the tremendous volume of sediment made available by undercutting of the spoil banks.

Another example of localized accelerated sediment yield to the bays is the rapid growth of the Colorado River delta across the east arm of Matagorda Bay. Prior to 1926 sedimentation at the mouth of the Colorado River was greatly impeded by a logjam in the lower part of the river which caused flooding and spreading of sediment over the lowlands. Between 1926 and 1930 the logjam was removed and the channel opened. As a result, the Colorado River built a delta across East Bay, a distance of four miles in about six years.

In the Lavaca River basin the soils of the Texas Claypan Area Land Resource Area are producing sandy sediment which clogs tributaries of the Navidad River such as West, Middle, and East Sandy Creeks. In the Guadalupe River basin large quantities of clean sand are present as bedload in Coleto, Perdido, and Turkey creeks and in the San Antonio River basin Manahuilla Creek contains a large quantity of sand bedload. The sand is clean, fine to medium grained quartz, and is evidently 10 to 15 feet deep in some places. The deposition of sand in these creeks has reduced their capacity to carry floodwaters within their banks.

Land Use and Management: Paramount in a discussion of land use and management problems is the noted absence of guidelines and incentives to encourage sound land use planning and the adoption and enforcement of meaningful land use policies. One objective in land use planning is to describe the compatible and conflicting uses and combination of uses for a land area using criteria designed to maximize the social benefits and minimize the social costs. In the Texas Coastal Basins improper land use planning,

such as buildings constructed in flood plains and on soils poorly suited for construction purposes, has resulted in costly flood damages, drainage and health problems, strucutral failures, and a host of other mistakes in real estate development. Soil erosion, loss of plant cover, and impairment of natural beauty have resulted because the natural characteristics of the land and man's use of it are in conflict. Many water related land resource planning problems can be minimized, and some can be avoided by planning for wise use of land resources.

A significant problem on rangeland is the encroachment of excess brush vegetation. Over three million acres of the study area has a severe brush problem. Control methods are limited and costly. Brush control is complicated by the assorted treatements necessary to control a variety of species growing in the same ecosystem. It has been estimated that 75 percent of all water transpired by all plants is used by these low value species. Unfavorable climatic conditions during the grass establishment period following brush control and reinfestation by brush species are factors that often prevent effective control after the first treatment.

Another problem associated with the management of rangeland in the semiarid section of the study area include grazing units which due to the lack of developed livestock water sources and the absence of fencing are too large for efficient management.

With the developing trend of subdividing land units into small tracts (5, 10, and 25 acres), there is added pressure on entities to supply service and technical assistance. Many of these landowners are available only on weekends to receive technical assistance on resource development and conservation.

A major problem associated with land use and treatment is the slow rate of planning and application of soil and water conservation measures on private land. Approximately 32 percent or seven million acres of the land in the study area has received essential conservation treatment measures. Factors which hinder this effort are absentee ownership, short-term lease arrangements, influence of rapidly expanding urbanization and industrialization and speculative land buying.

Environmental Conditions: Environmental problems seldom stem from simple causes, but usually rise out of the interplay of many contributing factors. These factors are influenced by expanding residential and industrial development.

Although progress has been made in waste treatment methods and facilities, untreated sewer effluent is discharged into streams

during high rainfall periods. It is estimated that two-thirds of the nearly 400 wastewater treatment plants in the study area are producing a poor quality effluent. The design capacity of some systems has been overburdened by rapidly increasing residential development. In addition, the effluent from septic tanks which collects in roadside ditches presents a potential health hazard in sections of the study area where soils are generally unsuited for proper septic tank operation. This condition provides excellent breeding places for mosquitoes as well as posing a serious possibility of contaminating ground water supplies.

The absence of satisfactory solid waste disposal sites presents very real environmental problems. Natural characteristics such as perched water tables and high rainfall along with the unfavorable attitude of people toward "dump" sites make it difficult to locate satisfactory sanitary land fills. Clandestine dumping of garbage and trash along roadways and into streams detracts from the esthetic quality of the area and contributes to the pollution problem.

Land use is not guided by any agreed upon standards. It is instead influenced by an abundance of sometimes competing, overlapping governmental institutions and programs, private and public attitudes and biases, and economic incentives which may be distorted. Certain taxes encourage land speculation and leapfrog development that has become the trademark of the urban-rural fringe. Residential expansion is producing mile after mile of suburbia with inadequate provisions for open space and environmental corridors.

Some sections of the study area are experiencing air pollution problems because of the unique meterology of the area and the high concentration of population and industry. The area is characterized by rapid heating and cooling of the land surface, updrafts during the day and downdrafts at night. The localities of prime concern are the Houston-Galveston area, Beaumont-Port Arthur-Orange area, and Corpus Christi area to some extent.

Vector control programs in the study area have generally kept most of the common vectors in check with the exception of the mosquito. Mosquitoes are mostly a nuisance problem, although periodic outbreaks of encephalitis have been attributed to this pest. Outdoor activities are seriously hampered during periods when mosquito populations are high.

Forestry: Half of the forest land in the study area is in private, non-industrial ownerships, much of which is in absentee ownership. On these lands the net annual growth rate of timber products per acre is only half of that presently reached on industry and National Forest holdings. This very low productivity is due to poor stocking

of commercially valuable trees - a result of long-term abuse and neglect. The potential for timber production and environmental development are both high and will be evaluated for the range of multiple forest uses.

Overcoming this problem of poor stocking and growth will go a long way toward meeting the increasing demand for forest products both in the basin, regionally and nationally. Unless production is increased, an "economic shortage" is predicted as early as the 1980's; impossibly high lumber prices, market dislocations, and priority changes are only some of the consequences of a supply-demand imbalance.

Among the barriers to achieving a balanced and accelerated forest productivity in the basin are: the landowners' general ignorance of forest land capabilities and his various forest management options, conflicting land use objectives, his limited time and money available for long-term investments, the risks of fire, insects, and disease to small ownerships. These, and other pitfalls are compounded not only by the effects of an "oligopoly-like" market for his timber products, but also by the present fragmented and distorted demands for the apparently less visible and less profitable uses such as water, wildlife habitat, dispersed recreation among others.

Forest insect and disease problems are always present, ordinarily at economically tolerated levels. The losses are cyclic in proportion to the national and periodic population build-ups of pine bark beetles, for example, the Forest Service cooperates with the Texas Forest Service in detection, control and timber salvage operations. When populations reached epidemic proportions in the 1957, 1965, 1972-1973 cycles, crash control and salvage operations were mobilized both to salvage the volumes of destroyed timber and to effect control of the outbreak.

Forest lands will be evaluated as to its capabilities to meet the demands made upon it for such as; timber, water, wildlife habitat, recreation, and other significant forest functions.

MAJOR PHASES IN PLAN FORMULATION

Plan formulation will be directed to meeting current and projected study items as identified by the desires of people in such a manner that improved contributions are made to society's preference for national economic development and environmental quality.

Plan formulation, in a series of steps will start with the identification of study items and culminate in a recommended plan of action. The process will involve an orderly and systematic approach to making determinations and decisions at each step so that the interested public and decision makers can be fully aware of the basic assumptions employed, the data and information analyzed, the reasons and rationales used, and the full range of implications of each alternative plan of action. The plan formulation process will consist of four inter-related phases.

Phase 1 - Setting and Recognition of Objectives

This phase will involve the initial identification of the problems, desires, and opportunities concerned with water and land resources and the initial definition of study items. Sufficient time will be spent with sponsors, local government units, and local people to gain a better understanding of the types of problems which exist and desires of all interests concerning economic growth and environmental considerations. These problems and desires will be examined with the sponsors and local interests to the degree that they can be given some definition to show how they relate to the two major objectives of national economic development and environmental quality.

Phase 1 is necessary because it:

1. Establishes the basis for the type and kind of resource inventories to be made.

2. Encourages planners to consider some of the alternatives to be examined in detail at a future time.

3. Provides a basis for writing a plan of work and developing a detailed work outline that is responsive to meeting sponsors' and local study items.

4. Initiates the information and education process among and between participants.

Initial contacts with sponsors and local groups have been accomplished through a series of local meetings throughout the basin. This effort has resulted in a compilation of study items from local groups. Composites of all concerns were used to aid in establishing the previously discussed study items.

Phase 2 - Evaluation of Resource Capabilities

In phase 2 an inventory of the land and water resource features pertinent to meeting the study items developed in the first planning

phase will be made in keeping with the multi-objective planning concept. Included will be selective inventories of the quantity and quality of water and land resources of the study area, an appraisal of opportunities for further use of those resources, and an examination of resource limitations for certain uses.

A series of local meetings are scheduled throughout the study to keep the public informed on study progress.

This phase calls for: (1) an inventory of existing resources of the study area in terms of (a) capability of the resources to meet needs without any planned project action and (b) capability of the resources to meet needs with institutional limitations alleviated or productivity enhanced through management plans alone; and (2) an analysis of the capabilities of resources to meet the specified objective. So that decision makers may better appraise and refine plan alternatives, the complementarity and competitiveness of resource use and demand will be considered. This will be done with an awareness of the provisions of federal and state laws and regulations and of interstate compacts regarding the allocation of water and existing rights to the use of water.

The U. S. Department of Agriculture will develop data needed for Departmental and State use as described in the objectives. This information will be available for use by the States in preparation of plans for the overall development, management, and use of water and land resources in the basin.

Phase 3 - Planning and Evaluation of Alternatives

The general types of development alternatives will be determined first. The 1972 OBERS Baseline Projections will be used as a framework for estimating the economic effects of specified water constraints and the economic implications of alternative programs for developing and managing the water and land resources of the area. These baseline projections will provide a framework for estimating demand for food and fiber and related requirements for land and water resources. OBERS as well as alternative projections, representing other levels of population and of resource development, will be analyzed in terms of their impacts on national economic development and environmental quality. Characteristics of present and future problems the solution to which can be related to water or resources, and the general approaches that appear appropriate for their solution will be described. Alternative plans will include projects and programs elements which are feasible and should be initiated within the next 10-15 years. State and local interests will indicate type, location, scope and priority of development.

Alternative solutions under USDA programs will be evaluated to the extent that reasonable estimates of the feasibility, from local and national viewpoints, of works of improvements can be made. Other projects beyond the scope of USDA programs may be requested and, as available, will be used in evaluating alternative plans.

Physical and economic effects of alternative solutions will be appraised to the extent necessary to satisfy basin residents and other decision makers of the soundness of the proposed general solutions.

Based upon identified study items, alternatives will be prepared and evaluated in terms of their contributions to the national economic development and the environmental quality objectives.

Phase 4 - Plan Development

Use will be made of the system of public information accounts to display the contribution of each proposed action on the three major objectives and QL. The plan will be of sufficient scope to identify the types, location, scale, and priority of development to meet future needs for goods and services and alleviate present and emerging economic and environmental problems that can be solved by local, state, and federal programs.

Under this accounting system each alternative developed will be appraised in terms of its physical and economic impact. The beneficial and adverse effects on national economic development, environmental quality, regional development, and social well-being accounts will be measured in quantitative units or qualitative terms appropriate to a particular objective. All beneficial and adverse effects will be shown in a system of accounts related to the objectives. Final decisions as to the recommended plan will be made by considering the differences and trade-offs among alternatives as to their beneficial and adverse effect on NED, EQ, SWB, and RD.

An environmental statement for this study will be prepared only if plan implementation is sought under new legislation.

General Statement Regarding Study

Studies and investigations will be limited in detail, but will be compatible with the nature and magnitude of the program to which they relate. Existing data and information will be used to the maximum extent possible in conducting the study.

Each planning phase consists of several major activities. Each major activity has one or more detailed activities. The activities are shown in the following work outline.

Revised Work Outline

Organization of the study, identification of study and much of the inventory concerns work that has been completed. This revised work outline begins with the study items, some of which have been completed or partially completed. Where time is shown it is that additional time required after July 1, 1973.

TEXAS COASTAL BASINS STUDY
WORK OUTLINE

PHASE I - Setting and Recognition of Objectives

Completed

PHASE II - Inventory of Resources

This phase will establish basic and projected information relative to basin resource production activities and human services.

Reconnaissance Investigation studies were conducted in all watersheds. Maximum use was made of maps, aerial photographs and other available data. Field data on problems and needs was obtained from on-site observations, regional and local planning leaders, municipal and community officials, and other residents familiar with local conditions. A procedural guide for conducting reconnaissance investigations was developed by the basin planning staffs.

Watershed Investigation studies will be made in watersheds which appear feasible from the reconnaissance investigations. A procedural guide for watershed investigation studies was developed by the basin planning staffs.

Problem and need components were established within each study item. Each component will be further refined as information is interpreted throughout this phase of study.

Agency Responsible Key:

FS - Forest Service
ERS - Economic Research Service
ARS - Agricultural Research Service
SCS - Soil Conservation Service

(G) - Geologist	(EC) - Economist
(B) - Biologist	(SS) - Soil Scientist
(SL) - Staff Leader	(SC) - Soil Conservationist
(H) - Hydrologist	(E) - Engineer

A. Resource Inventory and Identification of Problems and Needs

Study Item	Major Activities	Agency Responsible	General Procedures
Floodwater Damages (1)	1. Determine flood plain areas for selected watersheds	SCS (H), FS	1. Develop flood plain areas by measurements from road crossings and map study. For selected watersheds; develop rating curves, frequency discharge drainage area curves, and flood plain area depth curves.
	2. Inventory topographic and geologic conditions for potential works of improvement locations	SCS (H)	2. By use of quadrangle maps, locate potential works of improvement and cost estimates. Where needed, develop run-off curve number above potential works of improvement. Develop storage requirements for potential reservoirs.
	3. Determine agricultural land use and production on the flood plain crop and pastureland for projected conditions. a. Cropping patterns b. Acreage	SCS(EC), ERS, FS SCS(EC), ERS, FS	3a&b. Through field study and consultation with District Conservationist determine projected land use patterns and yields, areas inundated depths of inundation. Crop yields and acreage will be projected without project based on OBERS projections.
	4. Obtain average market value of residences, public buildings, and business establishments	SCS (EC), FS	4. Average market value of residences, business establishments and public buildings will be obtained from District Conservationists, landowners, local leaders and agencies, established residents and business officials.
	5. Determine areas subject to inundation and depths of inundation a. Agricultural areas b. Rural residential areas c. Cities, towns, urban areas	SCS(EC), FS	5. Types and amounts of floodwater damage will be estimated by contacts with the sources mentioned in item 4. Historical and/or synthetic analysis will be used to determine amounts and depths of inundation.
	6. Determine types and amounts of flood damages a. Crop and pasture b. Other agricultural damage c. Residential d. Commercial e. Industrial f. Transportation facilities g. Utilities h. Miscellaneous	SCS(EC), FS	6. Floodwater damages in selected watershed will be determined from published and unpublished data regarding kind of crops, yields, and crop history. Flood and drainage patterns will be studied from topographic maps, aerial photographs, CNI and forest survey data and field trips and studies.

Study Item	Major Activities	Agency Responsible	General Procedures
Drainage (2)	1. Prepare map and tabulation showing soils with a wetness hazard by Land Resource Areas and land use.	SCS (G, SC), FS	1. Review soil survey data and delineate soils indicating a wetness hazard. Display on map of appropriate scale. Superimpose vegetative map and further delineate forest cover types.
	2. Inventory and classify existing channel systems for adequacy, type of channel, flow condition.	SCS (E), FS	2. Use report prepared to comply with WS Memo 118 for classification according to type of channel and flow condition on existing watershed projects. Field check channels not in existing watershed projects to classify according to type of channel and flow condition. Field check and consult with District Conservationists to determine degree of adequacy.
	3. Determine downstream effects of potential systems (quantity and quality).	SCS (E), FS	3a. Quantitative effects of potential project systems will be estimated using routing and other procedures.
		SCS(H, G, B, E), FS	b. Quantitative effects of potential projects systems will be estimated based on applicable research data and supplemented with sample measurement data.
	4. Inventory of land adequately and inadequately drained.	SCS(SC, E)	4. Information will be obtained from District Conservationists.
	5. Determine effects of inadequate drainage on production costs and on crop yields.	SCS(SC, E), FS	5. Inventory secondary data prepared on existing watershed work plans, research data, personal interview with farmers and consultation with the extension service.
Water Quality (3)	1. Quantify by subbasins suitability for: a. Domestic b. Industrial c. Irrigation d. Unfit for any use	SCS(G)	1. Review quality criteria by use and from analysis prepared by other agencies and from sources available.
Water Shortage (4)	1. Inventory existing water sources a. Streams b. Ground water	SCS(H), FS	1a&b. Obtain data on existing water supply sources from federal and state sources. Display results of computer analyzed discharge records so that it may be easily interpreted.
		SCS(G)	1c. Review secondary information. Prepare maps showing lateral extent, quality, well capactiy, declines, and recharge area for main aquifers.

Study Item	Major Activities	Agency Responsible		General Procedures
Water Shortage (Cont'd)	2. Inventory present uses - project future demands (1980, 2000, 2020) a. Municipal b. Industrial c. Rural domestic and livestock d. Fish and wildlife e. Recreation f. Agricultural, other than irrigation, (fish-farming, livestock waste disposal, etc.) g. Navigation h. Irrigation i. Other	SCS (EC,E), FS, ERS	2 a,b,c, f,g,h.	Utilize data from Texas Water Development Board on present water uses, and present and projected water requirements. Forest Service will furnish present and projected water requirements for forest-based industries. Latest publications will be utilized as data sources.
		SCS (EC, B), ERS	2 d.	Use data from the Texas Parks and Wildlife Department. Projections will be made using ERS projections on population, income levels, etc.
			2 e.	Collect data from SCS, Texas Parks and Wildlife Department, Texas Forest Service, U. S. Forest Service, Texas Water Development Board, Corps of Engineers, and other summary reports. (a) Catalog units by surface acres feet. (b) Identify land by uses of surface waters (c) Select potential reservoir sites or stream segments suitable for recreational development. (d) Identify by water body, factors exerting negative effect on recreational use and development.

Study Item	Major Activities	Agency Responsible	General Procedures
Water Shortage (Cont'd)	3. Inventory potential water storage sites to meet future demands.	SCS (E, H), FS	3. Through field examination and map study potential water storage sites will be identified. Storage to meet yield will be based on regionalized curves considering percent chance of shortage. Provide forest land use information, volumes, release, etc., regarding potential sites.
Economic Conditions (5)	1. Human Resources a. Population sectors (1) Urban (2) Rural (3) SMSA b. Employment (1) Standard industrial classes (2) Unemployment (3) Underemployment cases and others c. Income (1) Sources (2) Per capita (3) Medium family (4) Distribution (5) Population sector d. Migration trends e. Age, education, and racial distribution f. Employment skills	ERS, FS	1 a-f. Inventory of human resources will be for years 1950, 1960, 1970, and project 1980, 2000, 2020. U. S. Census of Population and State Agency reports are primary sources. Whole county data will be used to describe the basin area.
	2. Industrial Resources and Activities a. Agriculture (1) Number, size, tenure of farm firms (2) Farm production and sales (3) Capital investments (4) Agricultural services industries	ERS, FS	2 a-d. Inventory agricultural statistics for years 1950, 1960, 1970, and project for 1980, 2000, and 2020 by county. Specified subbasin data will be tabulated. U. S. Census of Agriculture Statistical Reporting Service, and Forest Service are primary sources of data. Current land resources use inventory will be reported by hydrologic boundaries. Other sources of data for tabulation will be the U. S. Department of Commerce; and published and unpublished data on resources.

Study Item	Major Activities	Agency Responsible	General Procedures
Economic Conditions (Cont'd).	b. Minerals (1) Value of minerals produced (2) Types of location of mineral operations (3) Location of mineral deposits c. Manufacturing and processing (1) Specialization and volume of major classes (2) Major water using industries (3) Major manufacturing locations d. Commerce (1) Specialization and volume of major classes (2) Major trade centers		
	3. Public and Private Services a. Educational institutions b. Hospital facilities c. Governments (including law enforcement) d. Military installations	ERS	3 a-d. An inventory and prespective will be established for current services and their accessability within the area.
	4. Outdoor Recreation a. Types and amount b. Projected needs c. Outdoor recreation-related economic activities (including fish and wildlife harvest values)	ERS, SCS(SC,B)	4 a-c. Estimate the current demand for outdoor recreation for project to 1980, 2000, and 2020, without price demand schedule. Project changes in activities and facility needs. Estimate outdoor recreation-related economic activities and dollar volumes. Inventory data will be obtained from SCORP, BOR recreation inventory agency report and secondary sources.

Study Item	Major Activities	Agency Responsible	General Procedures
Economic Conditions (Cont'd)	5. Transportation a. Highways (miles) (1) Federal, state, and county (2) Total miles in prime agricultural area b. Railroads (miles) c. Air (1) Truck lines (2) Cities served d. Water (1) Facilities (2) Miles of navigable channels e. Pipeline (miles)	ERS	5 a-e. Transportation Texas Highway Department and U. S. Department of Transportation will be major sources for this inventory.
Recreation (6)	1. Tabulate surface waters and land available for recreation (public and private) a. existing b. planned or projected	FS, SCS(SC,B,E,H),ERS	1-3. Collect data from Texas Statewide Comprehensive Outdoor Recreation Plan (Latest Edition).
	2. Inventory outdoor recreation facilities (public and private) a. Existing b. Planned or projected	FS, ERS, SCS (SC, B, E, EC)	
	3. Determine present and projected outdoor recreation needs for 1980, and 2000 a. Water b. Land c. Facilities	SCS(SC, EC), ERS,FS	

Study Item	Major Activities	Agency Responsible	General Procedures
Recreation (Cont'd)	4. Appraise potential for outdoor recreation developments	SCS(SC), FS, ERS	4. Collect data from appraisal of potential for outdoor recreational development. Secondary source and field investigations data will be catalogued by recreation activity by planning regions and the total basin.
Fish and Wildlife (7)	1. Inventory wetland types	SCS(B, SC), FS	1. Wetland types will be classified according to guidelines in USDI Circular No. 39. Topographic maps, aerial photographs and SCS District Conservationist will be utilized for locations of the wetlands.
	2. Inventory fish and wildlife populations	SCS(B,SC), FS	2. Collect fish and wildlife population data by species and parishes (counties). Secondary data from the Texas Parks and Wildlife Department, Texas Water Development Board, Bureau of Sport Fisheries and National Marine Fisheries Service such as harvest records and census data will be used.
	3. Inventory wildlife habitat	SCS(B, SC), FS	3. The different habitat types such as bottomland hardwoods, open land, oak-pine, loblolly-shortleaf pine, etc. will be inventoried. Forest Service, Texas Parks and Wildlife Department, and SCS data will be used.
	4. Prepare checklist of birds, mammals, reptiles, amphibians, and fish	SCS(B, SC), FS	4. Use of secondary data and personal contacts with university personnel, bird-watching societies, wildlife federation and planning commissions.

Study Item	Major Activities	Agency Responsible	General Procedures
Fish and Wildlife (Cont'd)	5. Prepare habitat cover map	SCS(B,SC), FS	5. From data in No. 5.
	6. Inventory rare or endangered species	SCS(B,SC), FS	6. Use secondary data from Bureau of Sport Fisheries and Wildlife, Texas Parks and Wildlife Department, and personal contacts with field biologist and others in the basin.
	7. Project demands (Base Year 1980, 2000, 2020) a. Fishing b. Hunting	ERS,SCS,(B,SC),FS	7. Determine supply and demand for fishing and hunting from reports and information of ERS and Texas Parks and Wildlife Department.
	8. Determine physical potential for development or preservation to meet future demands	SCS(B,SC,E), FS	8. Field investigations and map studies will reveal areas that have a potential for development or preservation. These areas will be reviewed with state fish and wildlife interests.
Erosion (8) and Sedimentation (9)	1. Calculate present and future soil loss a. Sheet erosion (1) Cropland (2) Grassland (3) Forest land (4) Other b. Gully c. Streambank d. Roadside e. Flood plain f. Shoreline	SCS(G)	1. Use procedure from SCS Technical Release No. 51, Technical Guide No. 12, and field examination.
	2. Determine damages	SCS(G, EC)	2. Identify losses in production and economic return due to erosion damage (shown on erosion problem area map) by consultation with District Conservationist, landowners, geologists, and CES agents.
	3. Determine erosion rates on all forest land by causes	FS	3. Field investigations will be made to examine natural and impact areas. Soil losses will be associated with techniques and intensities of management.

Study Item	Major Activities	Agency Responsible	General Procedures
Erosion and Sedimentation (Cont'd)	4. Determine physical and monetary damages of sediment to a. Downstream reservoirs b. Flood plains c. Navigable channels d. Urban areas e. Highways, roads, and bridges	SCS(G,EC)	4. Use Technical Guide No. 12 and field sampling to determine physical damages. Determine loss in production and economic returns caused by sediment damages by contacting District Conservationists, landowners, and extension service.
	5. Inventory going programs to reduce sediment	SCS(G)	5. Compile list of programs designed to reduce sediment thru contacts with sponsors, District Conservationist, Corps of Engineers, and review published data.
	6. Determine sediment yields by impacts on forest lands	FS	6. Field investigations will be made to examine natural and impact areas. Sediment and soil losses will be associated with techniques and intensities of management.
	7. Determine amount and distribution of sediment to potential sites	SCS(G)	7. Use data from Reservoir Sediment Surveys and Suspended Sediment Samples, and Technical Guide No. 12.
	8. Determine sediment yield to outlets of watersheds	SCS(G)	8. Use Technical Guide No. 12 and reservoir sediment survey data.
	9. Determine sediment yield to bays and estuaries	SCS(G)	9. Same as No. 8 above.
Land Use and Management(10)	1. Inventory soil survey data a. Prepare generalized soil map for land use b. Show typical soils interpretation sheet c. Determine soil productivity groups	SCS(SS,SC,G)	1 a. Prepare generalized soil map based on county soil maps. Delineate crop suitability and and land use class.
		SCS(SS,G,SC)	1 b. Display typical soils interpretation sheet using example in publication entitled "Guide for Interpreting Engineering Uses of Soils" in report.
		SCS(SS,G,SC),ERS	1 c. SCS State Soil Scientist will group land capability units of similar productive qualities or suitabilities.
	2. Inventory land resources a. Major land use b. Ownership c. Land and water areas d. Prepare land use map e. Prepare vegetative cover type map	ERS,FS,SCS(SC)	2a,b,c,e. These four items will be established from field studies, CNI and forest survey data. Field studies will include interviews with other agencies, local officials and particularly with SCS District Conservationist and National Forest, State industrial, and consulting foresters and studies of aerial photography.

Study Item	Major Activities	Agency Responsible	General Procedures
Land Use and Management (Cond't)		ERS,FS, SCS(SC)	2 d. A land use map will be prepared utilizing the data obtained in Items 2a, 2b, and 2c.
		FS	2 e. Forest cover types and conditions classes will be mapped, displayed, and described in a system stratified at least by soil associations, subbasin and counties. The feasibility of developing this system into a land use system with analytic capability will be investigated and decided upon early in this phase.
	3. Inventory land treatment data a. Type and quantity applied to date and cost b. Type and quantity remaining to be applied and cost	SCS(SC)(G)(EC), FS	3a-b. Existing publications and data sources will be used and supplemented by consultation information from District Conservationists. Data from forest land will be derived from field studies, research data, and consultation with National Forest, State, and industrial foresters. Research data from sediment studies will be used where applicable.
	4. Inventory organizations, programs, and institutional factors affecting water and land resources.	SCS(SC),FS,ERS	4. Compile list of organizations, programs and institutional factors affecting land and water resource planning. Consult with sponsors, regional planning groups and organizations.
	5. Inventory land treatment needs	SCS(SC), FS, ERS	5. Land treatment needs will be derived from random sampling and forest survey data.
Environmental Conditions (11)	1. Identify sources and areas of land, air and water pollution	ERS, SCS, FS	1-5. Obtain data through published and unpublished reports, pertinent academic resources of institutions of higher learning, other Federal agencies, State and local agencies, local interviews. Expertise of the agencies directly involved in the study are to also be utilized. In various cases a staff member will be assigned charimanship of

Study Item	Major Activities	Agency Responsible	General Procedures
			a work group or be given responsibility to locate and obtain expertise for a given item to develop the required information. Investigate forest management procedures that might have an impact on known populations of rare or endangered species. Inventor forest habitat types related to endangered species.
		SCS,ERS, FS	1. Reports from Federal and State agencies responsible for air quality will be used as informational sources to identify types, sources, and effects of air pollution.
	2. Relate by subbasins suitability for the ground water and surface water a. Municipal b. Industrial c. Irrigation d. Rural domestic and livestock e. Fish and wildlife f. Recreation g. Agricultural discharge (fish, farming, livestock, etc.) h. Other		2. Obtain quality standards available for each stream and relate suitability for purposes mentioned in items 2a through 2h.
	3. Indicate degree and extent of turbidity in known turbid surface waters		
	4. Identify significant systems and locations of sewage, animal waste and solid waste disposal		
	5. Describe other environmental components: a. Rare and endangered plant and animal species b. Unique beauty, scenic, and wilderness areas c. Aesthetic values d. Historical, archeological and paleontological sites		

Study Item	Major Activities	Agency Responsible	General Procedures
Forestry (12)	1. Determine management and protection needs for forest lands	FS	1-2. Data on forest land will be derived from field studies, research data, consultation with National Forest, State, and industrial foresters, and existing publications.
	2. Develop forestry matrix which will display the several forestry factors and their impacts	FS	

B. Compilation of Inventory Data and Development of Present and Future Needs

Study Item	Major Activities	Agency Responsible	General Procedures
	1. Compile inventory data for development of present and future needs a. Floodwater damages b. Impaired drainage c. Water quality d. Water shortage e. Economic conditions f. Recreation g. Fish and wildlife h. Erosion i. Sedimentation j. Land use and management k. Environmental conditions	SCS, FS, ERS	1 a-k. Determine Present Conditions Organize, summarize, and collate inventory data for each study concern. Collate data with that collected for related study concerns to determine present limitations. Extent of problems, needs, and excesses for the study concern will be analyzed. Determine Future Conditions Based on projected population growth, various trends within the realm of each study concern and present resources, project demand to the future (1980, 2000, 2020) and determine future needs.

III. PLANNING AND EVALUATION OF ALTERNATIVES

A. Develop Alternative Plans

Study Item	Major Activities	Agency Responsible	General Procedures
	1. Form structures of alternative plans	SCS, FS, ERS	1. Array component needs and elements that are complementary to one another. State each need and select complementary elements from prior arrayment of component elements to the extent possible that will satisfy each need in a harmonious relationship. This will provide tentative frameworks for alternative plans. Within these frameworks develop tentative alternate plans for land and water resource development utilizing data obtained from resource inventory and identification of problems and needs.
	2. Evaluate benefits and costs of alternative plans in quantitative and qualitative terms	SCS, FS, ERS	2. Utilizing data from the resource inventory and considering the present and future needs, evaluate plans determining monetary benefits and costs or positive and negative effects where monetary values cannot be assigned.

B. Formulate Plans

Study Item	Major Activities	Agency Responsible	General Procedure
	1. Identify alternative plans that will provide varying levels of satisfaction for each major objective. One proposal for each major objective should optimize the level of satisfaction.	SCS, ERS, FS	1. Based on present and future needs, evaluate tangible component needs in terms of costs and benefits. Evaluate intangible component needs such as those included in the environmental objective in terms of positive and negative effects.
	2. Analyze the alternative plans to derive the extent of component needs and their complementarity, the available alternative means, the overall resource capabilities, etc.	SCS, ERS, FS	2. For each alternative plan, identify and assemble the relevant alternative means of meeting each component need for one of the major objectives. Repeat the process for each major objective.

C. Plan Selection Process

Study Item	Major Activities	Agency Responsible	General Procedures
	1. Prepare displays and accounts for each alternative	FS, ERS, SCS	1. Displays and accounting systems are described in the multi-objective guidelines.
	2. Determine the interests and priorities of all concerned public and private interests and groups.	FS, ERS, SCS	2. This will be done by working and listening sessions with sponsors, local interest groups, and individuals. Also, the results of the questionnaire will be helpful.
	3. Identify and clarify conflicts within and between the alternatives and resolve those that can be resolved	FS, ERS, SCS	3. The priorities, preferences, and conflicts will be analyzed and sifted out by a trial and error, pick and choose, try and fit process - directed toward the goal of narrowing down the alternatives to a viable minimum.

IV. PLAN DEVELOPMENT

Study Item	Major Activities	Agency Responsible	General Procedures
	1. Present the recommended alternative plans to the public and determine their preferences	ERS, FS, SCS	1. Prepare the plans selected in step III. C. for presentation to the public. The purpose of this is to obtain the public's preference for a final plan.
	2. Publish plan	ERS, FS, SCS	2. After obtaining public preference by a review of the selected plans, the staffs will proceed with developing and writing the final plan. A draft report will be prepared and mailed for review by concerned parties. Comments received will be incorporated into a final plan report.

ARRANGEMENTS FOR COORDINATION

The water and land resources appraisal as prepared by the sponsoring state agencies and USDA indicates the coordinated action required between the various State, local, and Federal agencies participating in the study. Participation by local groups is encouraged and will provide for the grass roots approach in the formulation of plans for the development and use of the water and land resources.

Coordinating Committee

The Coordinating Committee, consisting of representatives of the United States Department of Agriculture, the Texas Water Development Board, the Texas State Soil and Water Conservation Board, the Texas Water Rights Commission, and the Interagency Council on Natural Resources and the Environment, has been established. The Coordinating Committee will meet annually and at other times at the discretion of the Committee.

The main functions of the Coordinating Committee are as follows:

1. To define the objectives of the study.
2. To provide guidance for conduct of the study and preparation of a coordinated report.
3. Arrange for participation of other Federal and State agencies in the study.
4. To provide a means for full and continuing exchange of views between interested State and Federal agencies during the study.
5. To advise and assist all participating agencies regarding objectives, work assignments, and schedules.
6. To assist in resolution of study problems as they arise.
7. To designate work groups when needed for specific phases of the study.
8. To make periodic reviews of progress.

Coordinating Committee Members:

Agency	Representative
United States Department of Agriculture	Edward E. Thomas, Chairman State Conservationist Soil Conservation Service
Texas Water Development Board	Harry P. Burleigh Executive Director
Texas State Soil and Water Conservation Board	Harvey D. Davis Executive Director
Interagency Council on Natural Resources and the Environment	James M. Rose, Director Division of Planning Coordination
Texas Water Rights Commission	Joe Carter Chairman, TWRC

Planning Coordinating Committee:

The Planning Coordinating Committee consists of representatives of the U. S. Department of Agriculture, the Texas Water Development Board, the Texas State Soil and Water Conservation Board, the Texas Water Rights Commission, and the Interagency Council on Natural Resources and the Environment.

These committees will meet as the need arises. The committees shall serve as the channel for technical coordination for the Coordinating Committee. They have no formal power.

The main functions of the Planning Coordinating Committee are as follows:

1. To inventory data available from Federal, State, and local agencies.

2. To prepare a plan of work and revisions thereto.

3. To prepare a tentative timetable for completion of the basin work.

4. To serve as the clearinghouse for planning assignments made by the Coordinating Committee.

5. To recommend the state agency that could best perform each planning assignment.

6. To assist in resolutions of study problems as they arise, by preparing alternatives for the Coordinating Committee.

Planning Coordinating Committee Members:

Agency	Representative
United States Department of Agriculture	Bobby Reeves, Chairman River Basin Staff Leader Soil Conservation Service
Texas Water Development Board	Lewis B. Seward Principal Engineer Project Development
Texas State Soil and Water Conservation Board	G. E. Kretzschmar, Jr. Planning Engineer
Interagency Council on Natural Resources and the Environment	Wayne Brown Acting Coordinator
Texas Water Rights Commission,	Alfred J. D'Arrezo Environmental Science Analyst

Work Groups

Work groups will consist of individuals from agencies with the concern and the expertise for a common subject related to water and land resource planning and development.

The primary functions of work groups are:

1. To determine the data needed.
2. To determine the adequacy of available data.
3. To collect additional data.
4. To identify problems and needs.
5. Prepare and review reports for this phase and make recommendations to the planning coordinating committee for solving problems and meeting needs.

Fish and Wildlife Work Group:

Bureau of Sport Fisheries and Wildlife
Texas Parks and Wildlife Department
U. S. Forest Service
Texas Water Development Board
Texas Water Quality Board
Interagency Council on Natural Resources and the Environment
Soil Conservation Service

Recreation Work Group:

National Park Service
Bureau of Outdoor Recreation
Bureau of Sport Fisheries and Wildlife
Texas Parks and Wildlife Department
Corps of Engineers
U. S. Forest Service
Economic Research Service
Texas Highway Department
Texas Water Development Board
Interagency Council on Natural Resources and the Environment
Soil Conservation Service

Water Quality Work Group:

Agricultural Research Service
Environmental Protection Agency
U. S. Forest Service
U. S. Geological Survey
Texas Water Quality Board
Texas State Department of Health
Texas Parks and Wildlife Department
State Department of Agriculture
Railroad Commission of Texas
Texas State Soil and Water Conservation Board
Texas Water Development Board
Interagency Council on Natural Resources and the Environment
Soil Conservation Service

ADMINISTRATION OF THE SURVEY

Field Advisory Committee

The investigations of the United States Department of Agriculture will be carried out under the direction of the USDA Field Advisory Committee. This committee will consist of Edward E. Thomas, Soil Conservation Service, Chariman; Norman Landgren, Economic Research Service; and Carl Hoover, Forest Service.

The functions of the Field Advisory Committee will include:

1. Coordination of the department's survey activities and procedures.

Organizational Chart
TEXAS COASTAL BASINS
Type IV Study

COORDINATING COMMITTEE		
USDA (SCS, ERS, FS)	- Chairman:	Edward E. Thomas State Conservationist, SCS
TWDB	- Member:	Harry P. Burleigh Executive Director
TSS&WCB	- Member:	Harvey D. Davis Executive Director
ICNRE	- Member:	James M. Rose, Director Division of Planning Coordination
TWRC	- Member:	Joe Carter, Chairman TWRC

PLANNING COORDINATING COMMITTEE		
USDA (SCS, ERS, FS)	- Chairman:	Bobby Reeves River Basin Staff Leader, SCS
TWDB	- Member:	Lewis Seward, Principal Engineer Project Development
TSS&WCB	- Member:	G. E. Kretzchmar, Jr. Planning Engineer
ICNRE	- Member:	Wayne Brown Acting Coordinator
TWRC	- Member:	Alfred J. D'Arrezo Environmental Science Analyst

WORK GROUPS
Fish and Wildlife
Recreation
Water Quality

Revised July 1975

2. Maintenance of necessary field liaison and coordination with other departments, USDA agencies, states, and other concerned entities to assure that USDA field work is properly coordinated with that of other participants.

3. Preparation of the study plan of work.

4. Assist in arranging for participation of other Federal agencies in the study as needed.

5. Interpretation of national guidelines, instructions, and procedures to meet the requirements of the survey in a uniform manner.

6. Preparation, justification, and recommendation of project budgets to the Washington Advisory Committee.

7. Making periodic and special reports on progress, expenditures, and problems, as required by the Washington Advisory Committee and the parent services.

The Field Advisory Committee will meet twice per year and hold special meetings when needed as called by the chairman. The Plan of Work will be reviewed and updated at least annually.

Funding

Budget requirements are estimated as follows:

Agency	FY-1973	FY-1974	FY-1975	FY-1976	FY-1977
SCS	130,000	136,000	111,000	110,000	106,000
ERS	34,000	24,500	42,000	37,000	25,000
FS	12,500	27,000	18,000	14,550	10,850
TOTAL	176,500	187,500	171,000	161,550	141,850

It is estimated that $838,400 of Federal Funds will be required for the study over the next five year-period.

Staffing

Personnel requirements are estimated as follows:

United States Department of Agriculture - Soil Conservation Service

Staff Leader
Hydraulic Engineer
Agricultural Economist
Civil Engineer
Geologist
Soil Conservationist
Biologist
Engineering Technicians
Secretary
Clerk-Typist

Staff assistance will be assigned and scheduled as necessary to complete SCS area of responsibility.

United States Department of Agriculture - Economic Research Service

Economist

United States Department of Agriculture - Forest Service

Forester

State of Texas:

Texas Water Development Board

Staff assistance will be assigned and scheduled as necessary to maintain close liaison with respect to progress, problems, assitance needs, and data needs, and also to become informed about resultant plans relative to the State's interests and the Board's responsibilities.

Texas State Soil and Water Conservation Board

Staff assistance will be assigned and scheduled as necessary to carry out the agreed-on activities of the Texas State Soil and Water Conservation Board, including the coordination of activities that involve soil and water conservation districts and local entities.

Texas Water Rights Commission

Will assist by providing data concerning land and water resources and water rights, assist in coordination of interest of local entities and individuals as surveys and investigations are developed, participate in work group assignments, assist in the evaluation and use of data, and assist in report preparation on request.

Interagency Council on Natural Resources and the Environment

Staff assistance will be assigned and scheduled as necessary to maintain close liaison with respect to the progress of studies and activities carried out in the area which are correlative or parallel to the USDA study.

REPORTS

Progress Reports

Reports of progress of all investigative activities of each agency of the USDA will be kept current and referenced to the schedule of planned activities. This report will be made available to the USDA Field Advisory Committee for use in its scheduled meetings. The Field Advisory Committee will consolidate all progress reports and transmit a report to the Washington Advisory Committee after each Field Advisory Committee meeting.

The Coordinating Committee, composed of representatives of all participating State agencies and the USDA, will report progress of the respective agencies. The USDA representatives will include progress by these agencies in the overall report to the USDA Field Advisory Committee.

Special Reports

Special reports will be prepared as requested by the Field Advisory Committee. The Plan of Work will be reviewed for revision at least annually.

Alternative Plans Report

The Alternative Plans report will include the present and future demand for and supply of natural resources, the problems and needs, the alternative plans, and a description of additional authorities that USDA and other agencies may need. This report will guide the decision makers in selecting the Recommended Plan.

Recommended Plan Report

The Recommended Plan will be included in the final report. It will represent the general consensus of the decision makers in selecting a plan. An evaluation of the plan will be presented using the multi-objective procedure. Both early-action and long-term actions will be identified.

River Basin Report Outline

Chapter 1	Summary
Chapter 2	Introduction
Chapter 3	Problems and Objectives
Chapter 4	Economic Development and Projections
Chapter 5	Resource Base and Existing Programs
Chapter 6	Future Without Condition
Chapter 7	Needs
Chapter 8	Alternative Plans
Chapter 9	Preferred Alternative Plan
Chapter 10	Opportunities for USDA Programs: Development and Impact
Chapter 11	Coordination and Programs for Further Development

MILESTONE REPORT

TEXAS COASTAL BASINS

Milestone Description	Work Item	Finish Time
Basic Data on Land Use and Management	IIA(10)2	5 Aug 74
Basic Data on Environmental Conditions	IIA(11)1-5	12 Mar 75
Basic Data on Forestry	IIA(12)1-2	17 Mar 75
All Basic Data Compiled	IIA	18 Aug 75
Appraise Adverse and Beneficial Effects of Solutions to Study Items	IIB	27 Dec 75
Plan and Evaluate Alternatives	IIIA&B	20 Sept 76
Select and Evaluate Alternative Plans	IIIC	3 Jan 77
Draft Final Plan	IV	30 June 77

TEXAS COASTAL BASINS

STUDY ITEMS

- FLOODWATER DAMAGES
- IMPAIRED DRAINAGE
- WATER QUALITY
- WATER SHORTAGE
- ECONOMIC CONDITIONS
- RECREATION
- FISH AND WILDLIFE
- EROSION
- SEDIMENTATION
- LAND USE AND MANAGEMENT
- ENVIRONMENTAL CONDITIONS
- FORESTRY
- CRITICAL PATH

IIA(10)5- REFERS TO WORK OUTLINE

TO DEVELOP ALTERNATIVE PLANS THAT PROVIDE SOLUTIONS FOR THESE STUDY ITEMS, THE ACTIVITIES LISTED ON THIS SCHEMATIC WILL BE INVENTORIED AND EVALUATED.